Received November 9, 1769.

X. *An Account of ſome Improvements made in a new Wheel Barometer, invented by* Keane Fitz Gerald, *Eſquire, F. R. S. In a Letter to* Charles Morton, *M. D. Sec. R. S.*

DEAR SIR,

Read Feb. 22, 1770. I GAVE a former deſcription and drawing of a wheel-barometer of a new conſtruction, with regiſters to mark the riſe and fall of the mercury, which were publiſhed in the firſt part of the fifty-ſecond volume of the Philoſophical Tranſactions for the year 1761. As that inſtrument has continued to operate effectually by the weight of a few grains only, and the regiſters to mark the limits of the aſcent and deſcent of the mercury in the tube very exactly ever ſince, it has induced me to attempt a further improvement, which I have alſo found to anſwer effectually; and take the liberty of deſiring the favour of you to lay a deſcription and drawing of it before the gentlemen of the Royal Society, if you think a communication of the kind worth their notice.

As

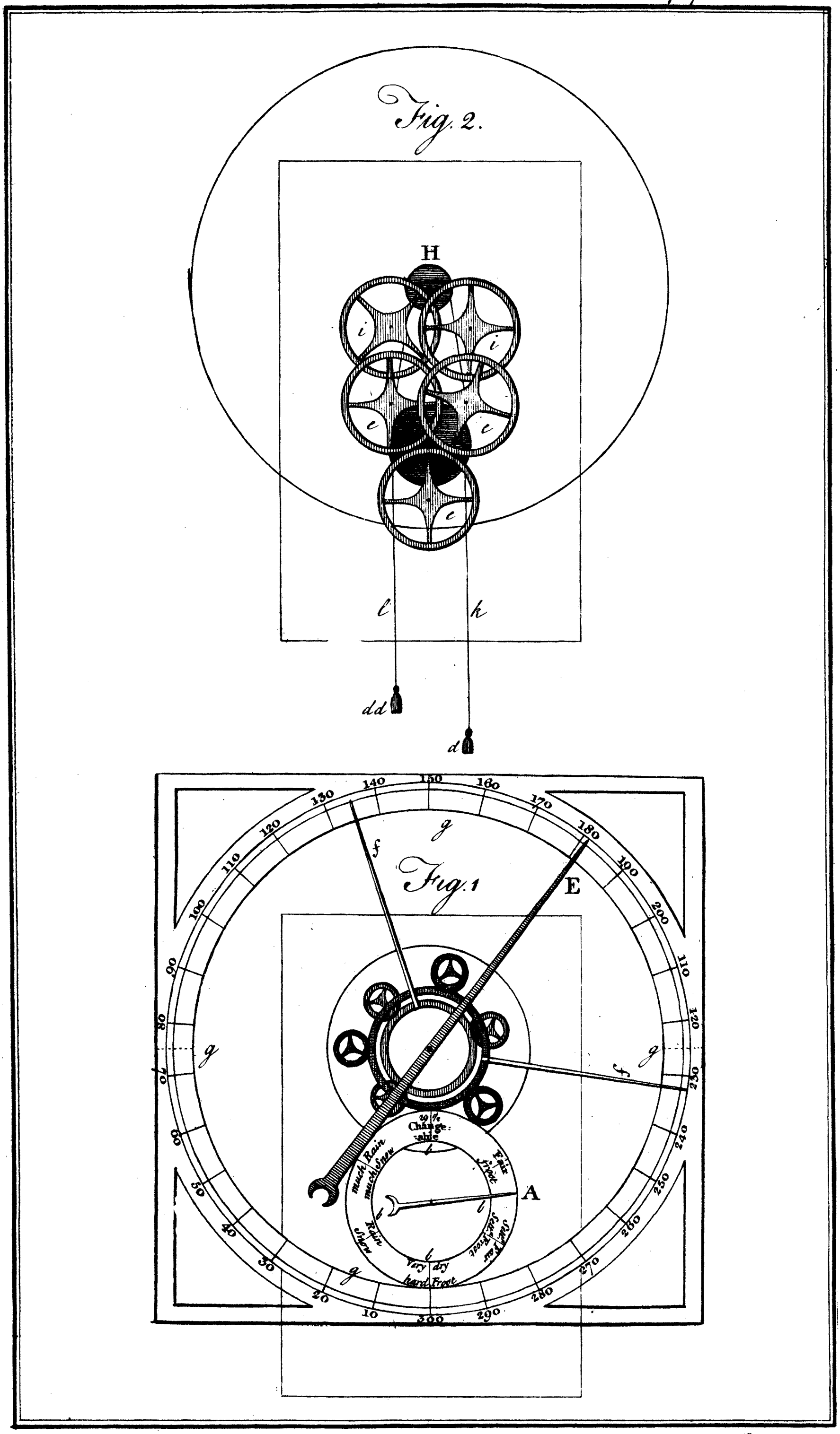
Fig. 2.
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Fig. 1
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As the improved inſtrument is like that already deſcribed, except in the dial-plate, and part of the wheel work, I have made a drawing of the parts, only, wherein they differ.

The ſmaller index A. (TAB. IV.) fig. 1. which moves in the circle *b*, *b*, *b*, *b*. about 4 inches diameter, is fixed on the axis of a double pulley B. fig. 2. nearly 1 inch diameter, which makes one revolution by a riſe, or fall of 3 inches of the mercury in the tube.

The pivots of the axis of the pulley B, are placed, each within 3 friction wheels, *e*, *e*, *e*, fig. 2. 2 inches diameter.

The larger index E. fig. 1. which moves in the circle *g*, *g*, *g*, *g*, — 10 inches diameter is placed on the axis of the double pulley H, about $\frac{1}{3}$ inch diameter, to make 3 revolutions exactly, for 1 revolution of the pulley B. Each of the pivots of the axis of this pulley is placed on 2 friction wheels *ii*, fig. 2.

The circle *b*, *b*, *b*, *b*, fig. 1. is divided into 3 equal parts; one for each inch the mercury riſes or falls in the tube, and is marked 28, to 31 inches, with rain, changeable, fair, &c. inſcribed, as other barometers generally are. Each of theſe parts is ſubdivided into 10.

The larger circle *g*, *g*, *g*, *g*, is divided into 300 equal parts, and marked 10, 20, &c.

The ivory cone, *d*, which reſts on the mercury in the tube, is ſuſpended by a ſilk thread *k*, fig. 2, which ſurrounds the outward pulley, B, and paſſes alſo 4, or 5 times round the outward pulley H, to which the end is faſtened.

The thread, *l*, by which the counterbalance, *dd*, is ſuſpended, ſurrounds in like manner the inward pulleys B, and H, but in a contrary direction. The weight *d* is about 8 grains heavier than the counterbalance, *dd*, which is fully ſufficient to move both the indexes, and alſo the regiſters; and is ſo ſlight a weight, as does not at all impede the riſing of the mercury in the tube.

As the cone *d* is ſupported by the mercury; when it riſes or falls in the tube, the pulleys B and H are moved round accordingly; and as a riſe or fall of 3 inches cauſes one revolution of the pulley B, and 3 revolutions of the pulley H, the indexes A, and E, placed on the axes of theſe pulleys, muſt be carried round the circles *b, b, b, b,* and *g, g, g, g,* in like manner.

The index A is moved $\frac{1}{3}$ of the circle *b, b, b, b,* by 1 inch riſe, or fall of the mercury, and the index E the whole circle *g g g g*; which, being about 30 inches in circumference, and divided into 300 equal parts, ſhews half a diviſion very perceptibly; ſo that the index E marks diſtinctly the 600th part of an inch riſe or fall of the mercury. And by placing the regiſters *f, f,* fig. 1. cloſe to the index, it muſt carry one along with it, when it moves; leaving it on its return, to mark the limits of its motion.

It requires a good deal of nicety and exactneſs in making and placing the friction wheels and pulleys; which require to be very light, and the pivots fine and ſmall. The machinery of this, as alſo of the former, was made by Mr. Vulliamy, watchmaker to her Majeſty; which is ſo well adjuſted, that it has

has not been in the leaſt out of order, in nine months I have had it; nor the other in nine years.

The exactneſs and facility with which an account of the variations in the weight of the atmoſphere may be kept, with the help of a barometer of this kind, muſt be very evident. I have frequently found, by extraordinary variations that have happened in the night, when the wind has riſen conſiderably, how little the obſervations made with common barometers are to be depended on; and have ſeveral times found by the regiſters, that the mercury had ſunk 50 or 60 diviſions; and one night particularly had ſunk 117 degrees, and returned within a degree and half of the place I had marked it on going to bed. When a ſtrong guſt of wind riſes, one may very plainly perceive the index of this latter barometer to ſink ſeveral diviſions, and riſe again as it abates.

Beſides the ſatisfaction that a barometer of this kind might afford to a curious obſerver, I ſhould imagine it might alſo be uſefully applied to the finding the height of the atmoſphere; with a much greater degree of exactneſs, at leaſt, than can well be afforded by any other.

It is generally allowed from experiments, that a column of air 72 feet high is equal in weight to 1 inch of water of the ſame baſe; ſo that, if the air were of equal denſity throughout, the atmoſphere could be little more than 5 miles high. But as the denſity is found to decreaſe by the difference of preſſure, and the air to be more rarified or expanded in proportion to its diſtance from the earth, it ſeems reaſonable to conclude, that if, by accurate experiments,

ments, the ratio of its decreaſe were found regular in proportion to the diſtance from the earth, its height might be eſtimated with a much greater degree of preciſion than it has been hitherto; though it ſeems generally allowed that its real height cannot poſſibly be aſcertained.

The impoſſibility of obſerving the difference of the preſſure of the atmoſphere at ſmall diſtances with accuracy by a common barometer, the ſcale of which is but 3 inches, is very evident; how far this inſtrument, the ſcale of which is 90 inches, might be conducive to the purpoſe, is ſubmitted to the judgment of others.

I ſhould imagine it would not be difficult, with a proper teakle, to raiſe a barometer of this kind gently, as high as 200 feet; and if it were raiſed from the ground, and let down again from each diſtance of 20 feet, the regiſters would mark very exactly to the 600 part of an inch at what height the mercury ſtood at each diſtance; ſo that the weight of each column of air of 20 feet, to the height it could be raiſed, would be found pretty exactly. And if a proper apparatus were fixed for raiſing the barometer, the experiments might be repeated, as often as requiſite, with very little trouble.

Experiments of this nature cannot well be made by a ſingle perſon; but if an inſtrument of the kind ſhould be deemed uſeful for the purpoſe, I ſhould very willingly lend it, and alſo any aſſiſtance I could give, in making the experiments.

I ſhall with great pleaſure ſhew you the inſtrument whenever you favour me with your company;

or

or to any of the gentlemen of the ſociety, who may think it worth examining.

I am, SIR,

Your moſt obedient ſervant,

Poland Street,
Nov. 8, 1769.

Keane Fitz Gerald.

Deſcrip-